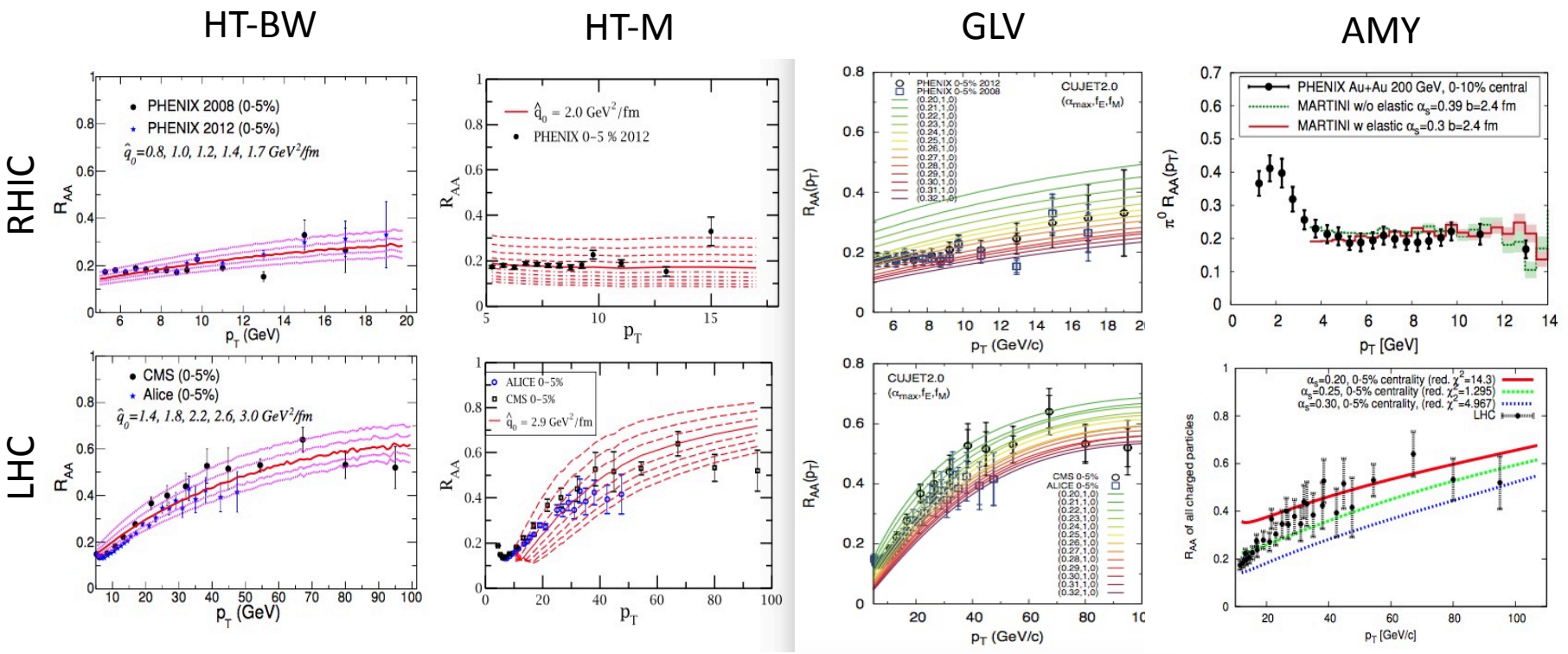
Physics Motivation

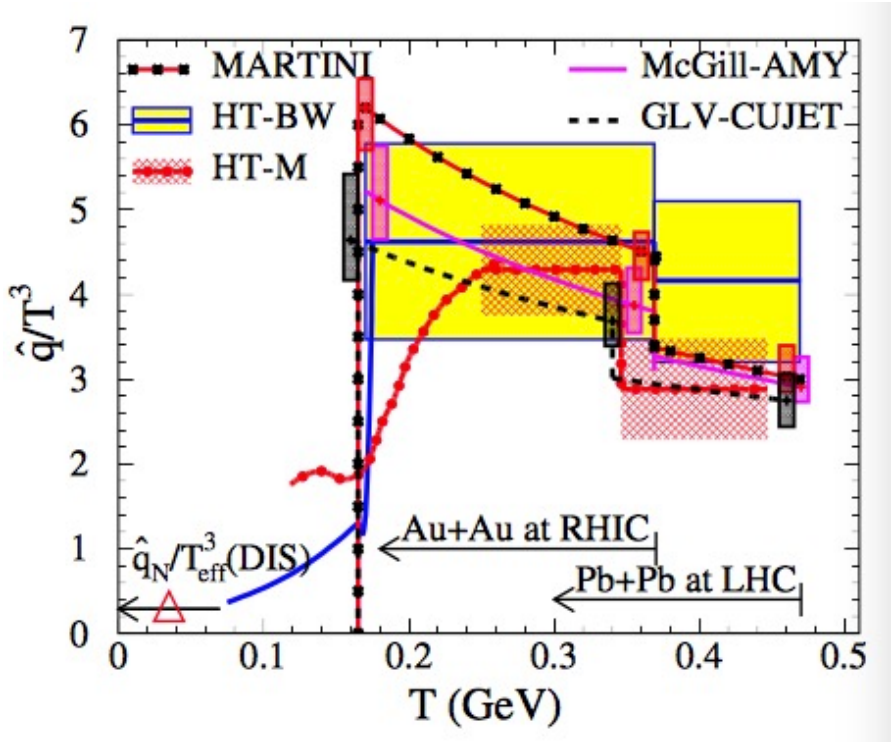
Compare physics model to experimental data and extract crucial parameters that quantify the properties of the quark-gluon plasma created in relativistic heavy-ion collisions.

Example: JET Collaboration work [PRC 90 (2014) 014909]



Physics Motivation

Constraint $\hat{q}$ from the JET Collaboration



$\hat{q}$: transverse momentum broadening of jet per unit time inside a medium due to elastic scattering with the medium

- Single parameter is used $\hat{q}$ or α_s for each model
- Each model is compared to only one set of experimental data from RHIC and one from LHC separately
- A jump of $\hat{q}$ as function of temperature (T)
- Smooth function w.r.t. T needs multi-dimensional parameter space and simultaneous comparison to multiple data sets – ***computational expensive***

Physics Model: Linear Boltzmann Transport

Monte-Carlo based transport model for medium-modified jet evolution in heavy-ion collisions (developed by the LBL-CCNU group)

[PRL 111 (2013) 062301, PRC 94 (2016) 014909, arXiv:1704.03648]

Simultaneous description of single hadron R_{AA} from RHIC to LHC

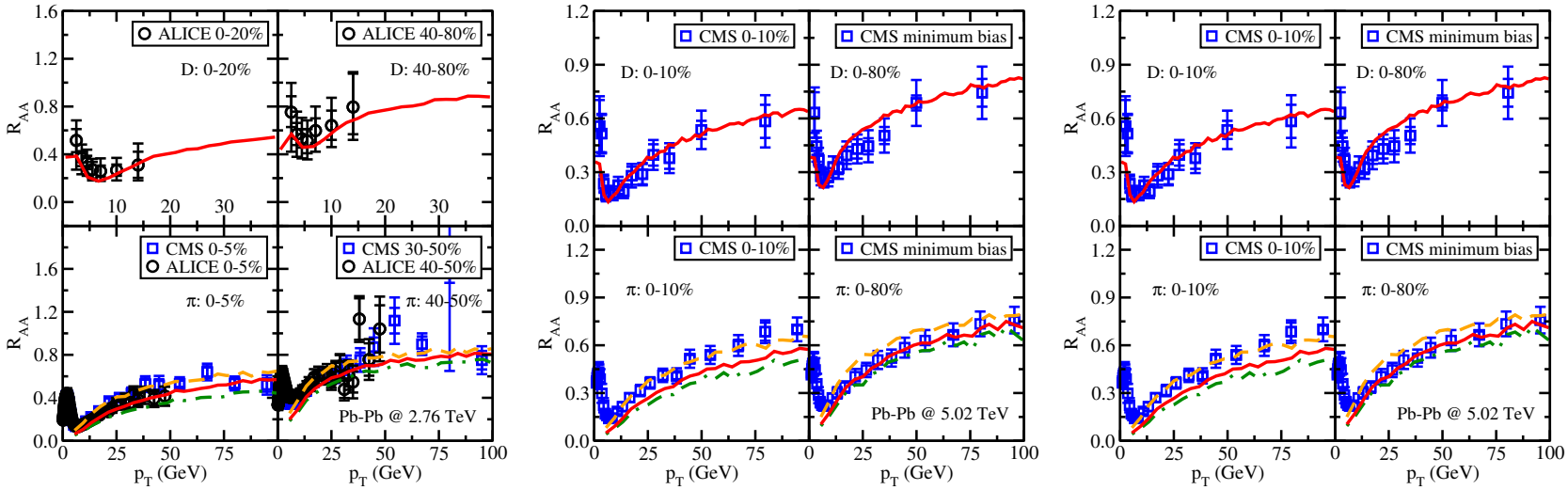
2-dimensinal parameter space ($\alpha_s^{\rm med}$ and $\Lambda^{\rm jet}$):

(1) fixed strong coupling $\alpha_s^{\rm med}$ for thermal medium (low energy scale)

(2) Running coupling constant for jet-medium interaction

$$\alpha_s^{\rm jet} = \frac{4\pi}{9}\left[\ln\left(\frac{ET}{\Lambda^2_{\rm jet}}\right)\right]^{-1}$$

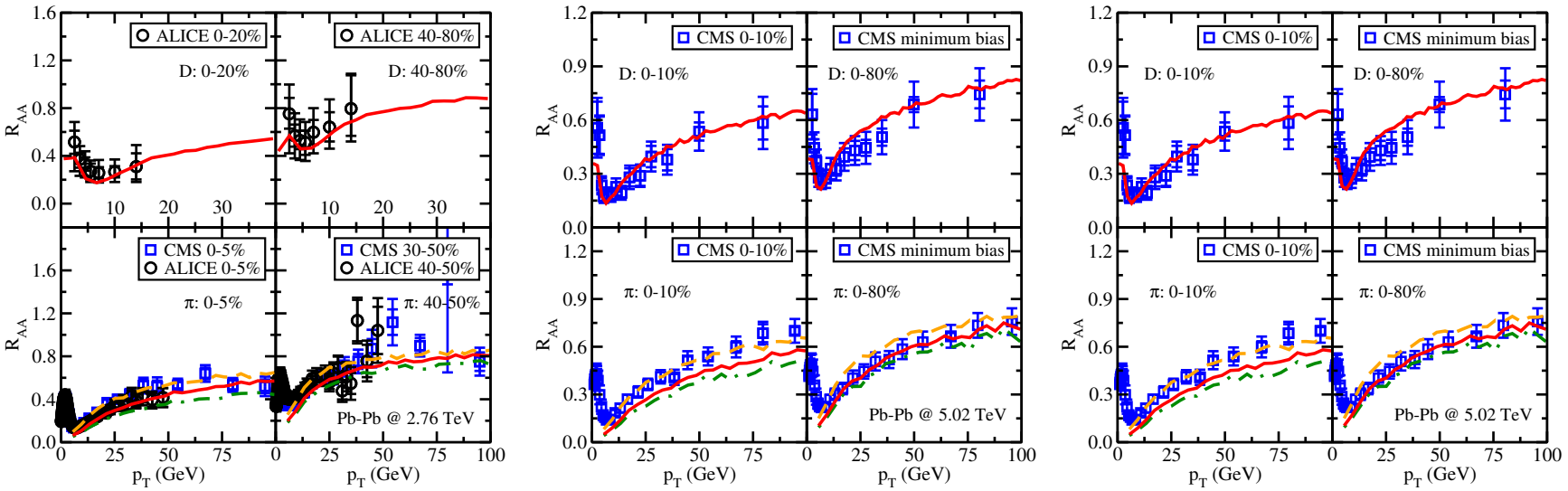
including energy and temperature dependence



In this work

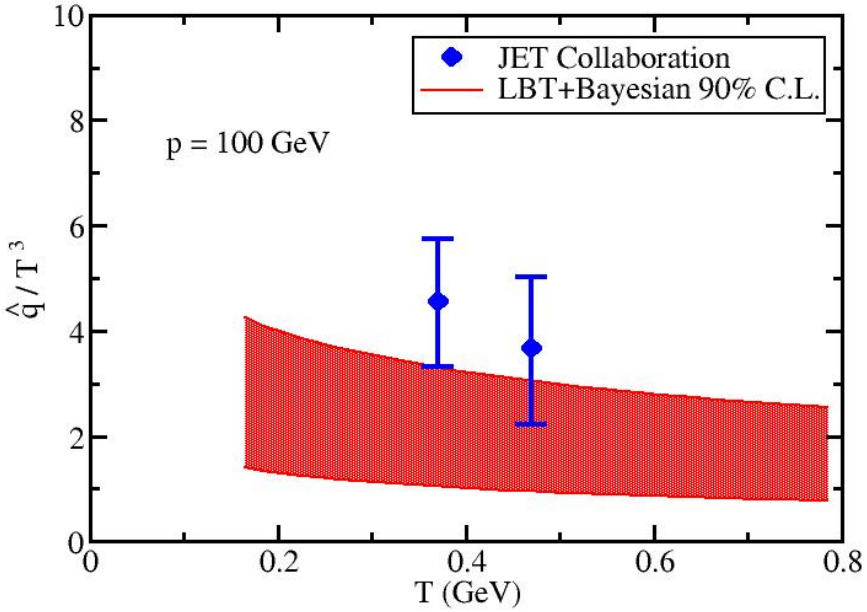
Extract $\alpha_s^{\rm med}$ and $\Lambda^{\rm jet}$ by calibrating LBT model calculation to experimental data of light flavor charged hadron R_{AA} at AuAu@200GeV, PbPb@2760GeV and PbPb@5020GeV simultaneously (two centrality bins for each collision system, 6 data sets in total)

Heavy flavor hadron is not included – more complicated in physics and may involve more model parameters (future effort)

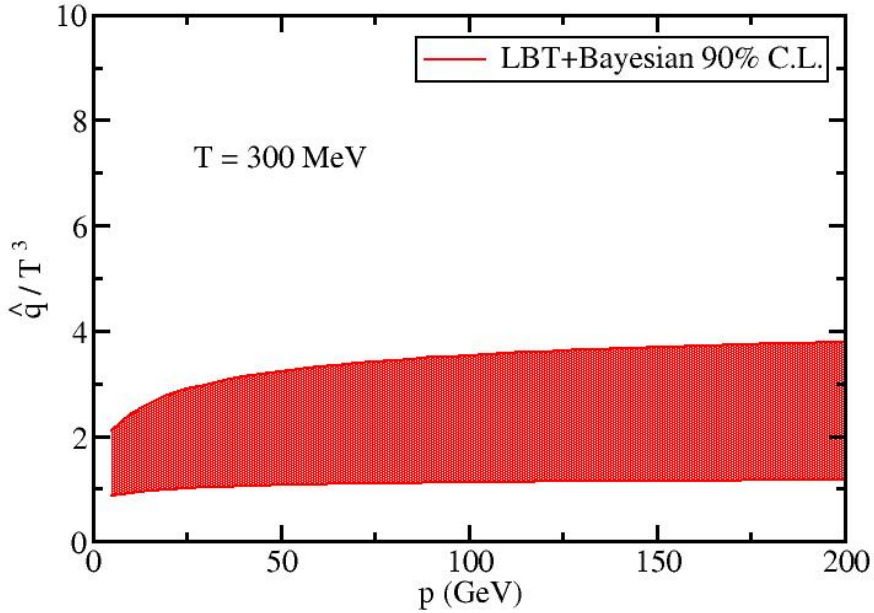


Bayesian analysis instead of eyeball fit to the lower 6 sets of experimental data

Extracted $\hat{q}$ from LBT + Bayesian analysis



temperature dependence



momentum dependence

Not inconsistent with previous JET collaboration work.

Hint of smaller band for $\hat{q}$

- Full Monte-Carlo implementation vs. semi-analytical calculation
- Inclusion of elastic scattering in LBT
- Need more sophisticated parametrization of the temperature dependence of α_s